

New Hampshire Volunteer River Assessment Program

LAMPREY RIVER

2000

Water Quality Monitoring Report



February 2003

STATE OF NEW HAMPSHIRE
Volunteer River Assessment Program
2000
LAMPREY RIVER
Water Quality Report

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1. VOLUNTEER RIVER ASSESSMENT PROGRAM OVERVIEW

VRAP (“vee-rap”) supports watershed organizations in their efforts to monitor river water quality. The primary focus of VRAP is to provide volunteers with river monitoring guidelines, equipment loans, and technical training. DES also incorporates applicable volunteer monitoring results into its evaluation of New Hampshire surface waters. Annual reports for each VRAP river include a summary of monitoring results and recommendations for future water quality sampling. VRAP aims to foster public understanding and stewardship of river systems and to increase available water quality information about New Hampshire rivers and streams.

VRAP loans and maintains water monitoring kits that include meters and supplies for on-site measurement of five basic water quality parameters: water temperature, dissolved oxygen, pH, specific conductance (conductivity), and turbidity. The investigation of these and additional parameters such as nutrients, metals, and bacteria is conducted by state water quality personnel and may be augmented by volunteer sampling. Sampling additional parameters comes with the cost of analysis, which can be covered by an assortment of fundraising activities such as association membership fees, special events, and in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. Water quality results are also used to determine if a river is meeting surface water quality standards. Volunteer monitoring results meeting DES’s Quality Assurance and Quality Control (QA/QC) requirements supplement the efforts of DES to assess the condition of New Hampshire surface waters. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at www.des.state.nh.us/wmb/Env-Ws1700.pdf or (603) 271-1975.

VRAP typically recommends sampling every other week during the summer, and citizen monitoring groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions. Each year volunteers arrange a sampling schedule and design in cooperation with the VRAP Coordinator. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency.

Each VRAP volunteer must attend an annual training session to receive a demonstration of monitoring protocols and sampling techniques. Training sessions are an opportunity for volunteers to come together and receive an updated version of monitoring techniques. Training sessions are typically conducted outdoors near surface waters for an interactive demonstration. During the training volunteers have a chance to practice using the VRAP equipment and may also receive instruction in the collection of samples for laboratory

analysis. Training is accomplished in approximately three hours, after which volunteers are certified in the care, calibration, and use of the VRAP equipment.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. VRAP aims to visit volunteers during scheduled sampling events to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. Volunteers forward water quality results to the VRAP Coordinator for incorporation into an annual report and state water quality assessment activities.

Applicable volunteer data are input to a water quality database, and considered (along with other reliable sources of data) during periodic DES water quality assessments. Assessment results and the methodology used to assess surface waters are published by DES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act.

More than fifty VRAP volunteers sampled five rivers regularly during the year 2000. VRAP 2000 rivers include the Lamprey, Exeter, Cocheco, Sugar, and Baker Rivers, as well as preliminary sampling on several additional rivers and streams. These accomplishments were made possible by the hard work and dedication of citizen volunteers and many additional people who helped to plan, support, and carry out these monitoring efforts.

2. PROJECT SUMMARY

In 1998 the Lamprey River Watershed Association (LRWA) spearheaded the formation of a volunteer water quality monitoring program on the Lamprey River. Monitoring has been accomplished through a partnership among several groups with a strong interest in the health of the river, local wildlife, aquatic recreation, and the educational opportunities the river offers us all. The LRWA and other watershed residents have monitored the river for several years, and have been successful in expanding the sampling program.

3. RESULTS, DISCUSSION, AND RECOMMENDATIONS

This section includes a description of the Lamprey River VRAP 2000 monitoring locations and results, a discussion of the results in comparison with New Hampshire water quality standards, and recommendations for future sampling and watershed investigations. The VRAP monitoring locations, "stations", are discussed from upstream to downstream (see Appendix A for a list of stations). Results are presented in graphs and text prepared by VRAP, and tables including all monitoring results from each station are located in Appendix B. The discussion of the results includes recommendations for future sampling and investigations that will contribute to the assessment of water quality conditions.

The water quality information collected at each station is summarized in a table that provides the reader with an overview of the monitoring activities and results. The table can be used as a quick reference for the reader; results not meeting state water quality criteria do not necessarily indicate a violation of water quality standards. The summary table indicates: (1) the number and type of samples collected, (2) the number of samples collected according to quality assurance and quality control requirements, (3) the number of samples not meeting state water quality criteria, (4) the range of the measurements, and (5) abbreviated water quality standards.

The presentation and discussion of the volunteer results focuses primarily on three parameters: DO, temperature, pH, and bacteria. These parameters are the core of the VRAP monitoring system, and have relatively straightforward standards that lend themselves to the assessment of individual results. These results can contribute directly to the determination of fishable and swimmable river and stream conditions, which is often a primary volunteer monitoring goal. This section includes graphs of dissolved oxygen (DO) concentrations with water temperature, and *E. coli* bacteria results (if collected). Please see Appendix C for descriptions of the water quality parameters analyzed under VRAP during 2000 and the associated New Hampshire surface water quality standards (SWQS) for Class B waters.

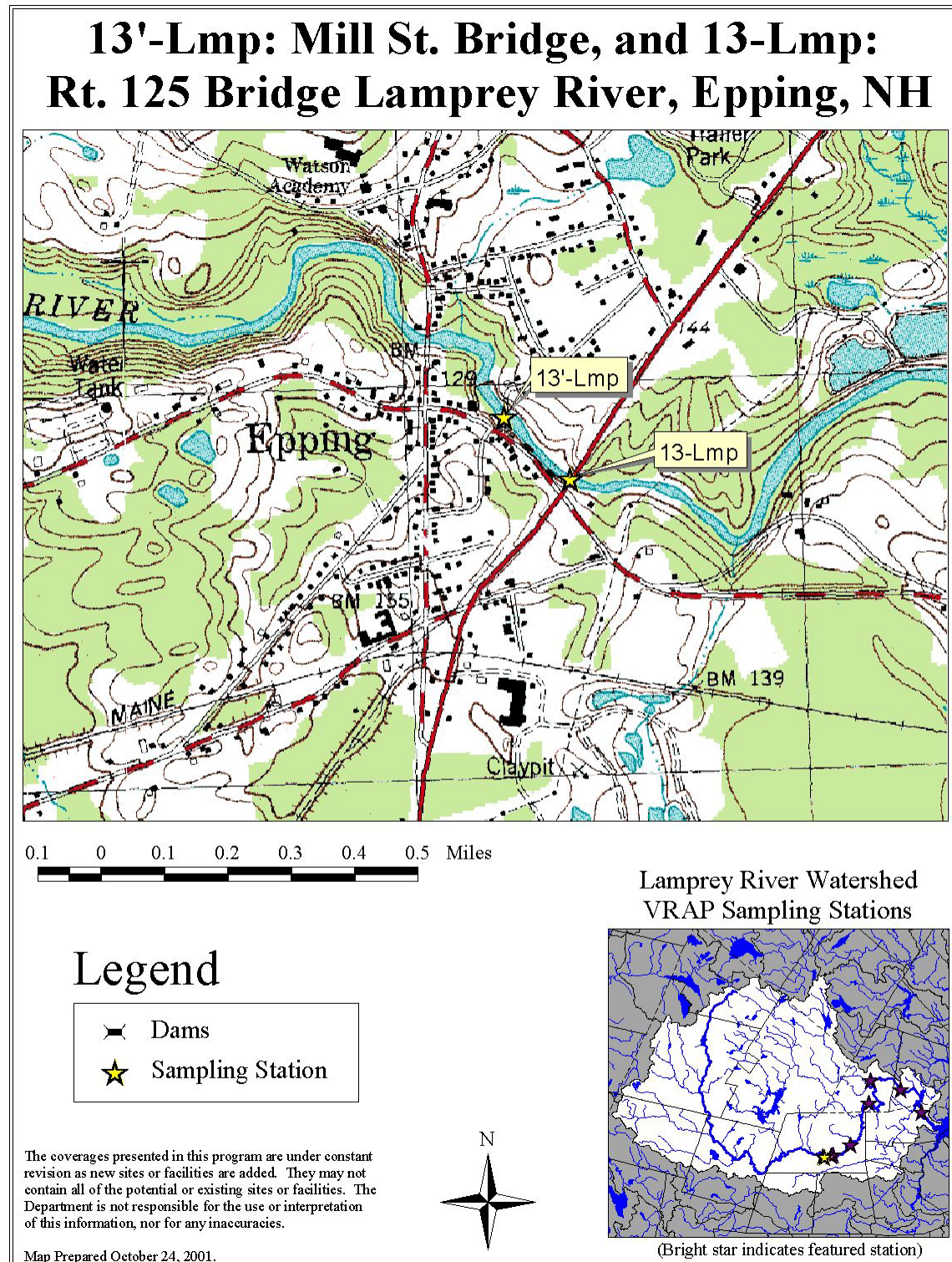
The reader should note that discussion is limited to those parameters at each station that do not meet state criteria. For example, since pH is the only parameter at 13-Lmp that exceeded state criteria, only pH will be discussed in detail. However, recommendations are not limited to parameters with results that fall outside state criteria.

VRAP aims to provide a mechanism for citizens to contribute to the ongoing process of surface water quality assessment. Recommendations for future monitoring activities and watershed investigations are included in this report following the results and discussion. Also included are recommendations for improvements in sampling techniques to encourage volunteers to adhere to quality assurance and control measures.

Volunteers are encouraged to sample their rivers and streams on a long-term basis. Much of the information volunteers collect profiles river and stream locations for the first time. Several (five to ten) years of good quality measurements will be needed to begin to decipher water quality trends and the status of rivers and streams relative to the New Hampshire surface water quality standards. Water quality data from the stretch of river sampled by volunteers are presented in graphs in Appendix D. These graphs are included in the report to show how water quality conditions change from upstream to downstream. The current report format will describe water quality conditions on a station-by-station basis.

All results generated by the Exeter River VRAP 2000 were collected using the VRAP Field Datasheet and Field Sampling Protocols, 2000 (see Appendix E).

3.1. 13'-Lmp: Mill Street Bridge, Epping, NH



3.1.1. Results and Discussion

Fourteen measurements for dissolved oxygen, pH, turbidity, and conductivity were made in the field using handheld meters. Six samples were collected for *E. coli* bacteria. All measurements and samples met the QA/QC requirements, but pH data indicate that the Lamprey River at 13'-Lmp in the year 2000 did not meet Class B Water Quality Standards for this parameter (see Table 1).

Table 1. Monitoring Summary: 13'-Lmp. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standard
DO (mg/L)	14	14	0	7.34 - 9.85	>5
DO (% sat.)	14	14	0	82.4 - 90.2	>75
pH (Std. Units)	14	14	2	6.39 - 7.31	6.5-8.0
Turbidity (NTUs)	14	14	0	0.65 - 6.5	<10 NTU above background
Conductivity (µmho/cm)	14	14	0	106.5 - 176.3	NA
<i>E. coli</i> (Cts/100mL)	6	6	0	10 - 320	<406

3.1.1.1. Dissolved Oxygen

Dissolved oxygen in the river at 13'-Lmp remained well above the minimum required concentration of 5 mg/L (see Figure 1). The Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day.

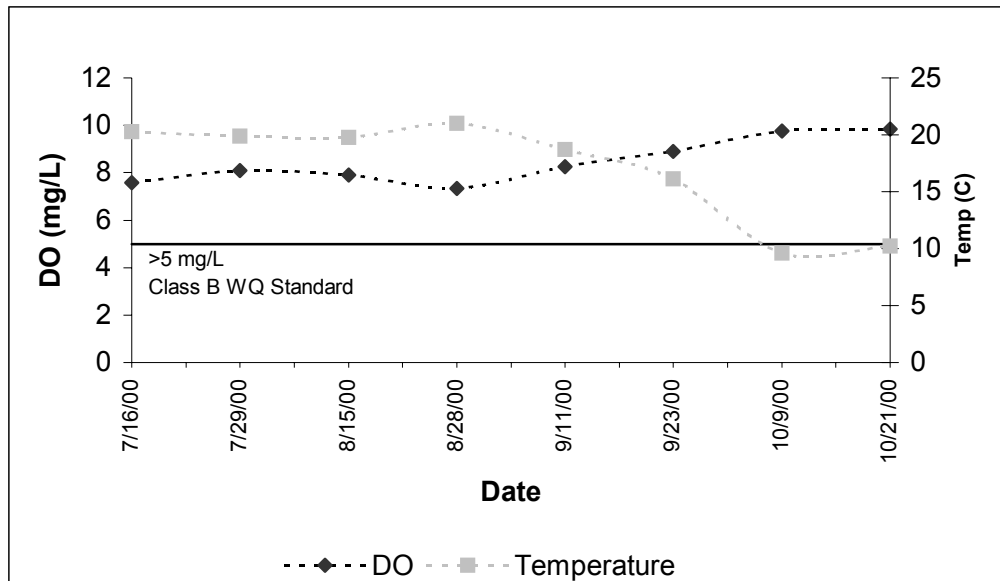


Figure 1. Dissolved Oxygen (DO) Concentration vs. Temperature. Lamprey River at 13rd-Lmp, Mill Street Bridge, Exeter, NH. VRAP, Year 2000.

3.1.1.2. pH

The pH at this location, ranging from 6.39 to 7.31, was measured below the state standard range on two of fourteen occasions. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

3.1.1.3. E. coli

E. coli levels were well below the standard for the summer of 2000. However, there is a large increase in bacteria counts in August (Figure 2). Abrupt increases in bacteria counts, even when below the standard, will be better understood by a more detailed account of weather on the day of and days preceeding sampling.

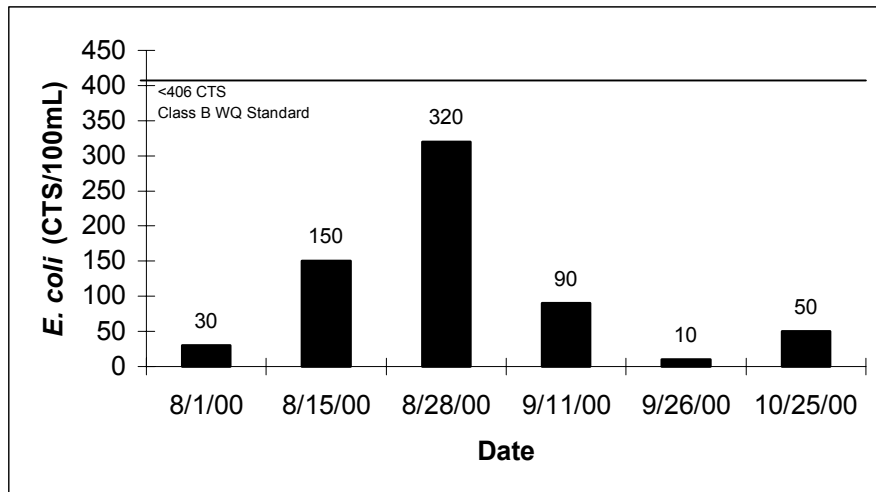


Figure 2. *E. coli* Bacteria Counts. Lamprey River at 13'-Lmp. Mill Street Bridge, Epping, NH. VRAP, Year 2000.

3.1.2. Recommendations

- Baseline Monitoring:** VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report. Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all weather conditions, and to ensure that this area of the river remains within standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES, as well as local decision makers.

Special attention should be paid to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with the water quality data. Without a record of weather conditions, it is extremely difficult to speculate on the cause of water quality conditions.

- Dissolved Oxygen:** Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

Volunteers are encouraged to conduct future sampling efforts in the early morning (5:00-8:00 a.m.), when DO levels are typically lowest. Results obtained during the afternoon hours may not reveal incidences of oxygen depletion in the river, although this information will contribute to the documentation of daily and seasonal water quality variability. Samples within the early morning hours will help determine the lowest concentrations of oxygen in the river, and help alert volunteers and DES to concentrations below the standard.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

- *pH*: Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process will not be completed in the short term, because of the variability of water quality and the amount of research required. Volunteers may choose to plan one of the following three phases each year, until a determination can be made in cooperation with DES:

Phase I:

As a first response to low pH measurements, volunteers can investigate the immediate drainage area to determine if the river is receiving wetland flow. Are there wetlands in the area that are potentially influencing water quality at this location? A simple way to answer this question would be to walk around the area looking for wetlands influencing the station. Topographic and GIS (Geographic Information Systems) maps may also provide useful information.

Phase II:

If wetland drainage is present, the next step to determining the influence is to sample upstream from the wetland, if possible. If volunteers sample upstream from a wetland and discover that pH is within the standard range, then it is likely that the wetland itself is contributing to low pH in the river. If the pH remains low upstream from the influencing wetland, then it is possible that there is another source of acidity even further upstream. Continue to investigate upstream until all possible influences have been documented.

Phase III: If volunteers have determined that wetland drainage is influencing a monitoring station, then further information about the nature of that influence must be gathered. Is the wetland in a natural state or

impacted by surrounding areas? DES will work with volunteers to make this determination.

- *E. coli*: Continued bacteria sampling at this location is encouraged. Bracketing the area, sampling upstream and downstream from the site, will help define the stretch of the river potentially experiencing elevated bacteria levels. *E. coli* bacteria comes from a variety of sources, including the intestines of all warm blooded animals, polluted runoff, failing septic systems or inadequate sewer connections, and flow from wetland areas. Bracketing is usually the first step in determining the extent and cause of elevated bacteria levels.

Wet weather studies conducted by DES attempt to sample bacteria levels before peak storm flow, during the peak storm flow, and post peak bacteria levels. Typical DES wet weather studies include sampling at one, two, three and five hours after the peak.

3.2. 13-Lmp: Route 125 Bridge, Epping, NH:

See map in Section 3.1 for station location.

3.2.1. Results and Discussion

One measurement for dissolved oxygen, pH, turbidity, and conductivity, were made in the field using handheld meters. Six samples were collected for *E. coli* bacteria. All measurements and samples met the QA/QC requirements, but the pH measurement indicates that the Lamprey River at 13-Lmp in the year 2000 did not meet Class B Water Quality Standards for this parameter (see Table 2).

Table 2. Monitoring Summary: 13-Lmp. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standard
DO (mg/L)	1	1	0	8.51	>5
DO (% sat.)	1	1	0	91.3	>75
pH (Std. Units)	1	1	1	5.78	6.5-8.0
Turbidity (NTUs)	1	1	0	0.85	<10 NTU above background
Conductivity (µmho/cm)	1	1	0	162.6	NA
<i>E. coli</i> (Cts/100mL)	6	6	0	30 - 260	<406

3.2.1.1. Dissolved Oxygen

The Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation is made using multiple measurements of saturation collected per sampling day. Therefore, DO saturation at this location requires further investigation.

3.2.1.2. pH

The pH at this location was measured below the state standard. Station conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands, then the low pH measurements are not considered a violation of water quality standards. In this case, additional information about factors influencing pH levels is needed.

3.2.1.3. *E. coli*

E. coli bacteria counts at 13-Lmp were within standards throughout the summer of 2000 (see Figure 3). However, bacteria counts over two different periods of sixty days showed results below the standard range. Analysis of weather effects on these results, was not conducted, due to a lack of information about weather conditions.

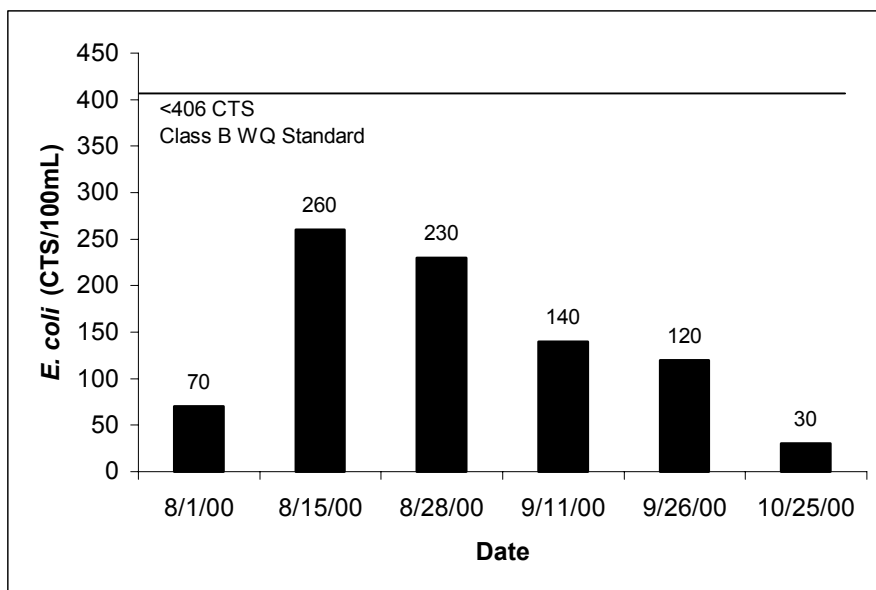


Figure 3. *E. coli* Bacteria Counts. Lamprey River at 13-Lmp, Route 125 Bridge, Epping, NH. VRAP, Year 2000.

3.2.2. Recommendations

Baseline Monitoring: Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all weather conditions. VRAP volunteers are making an increasing amount of water quality data available, in some locations for the very first time. The sampling that has taken place has helped create the recommendations in this report, and VRAP monitoring augments the data collection and river management efforts of DES as well as local decision makers. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations.

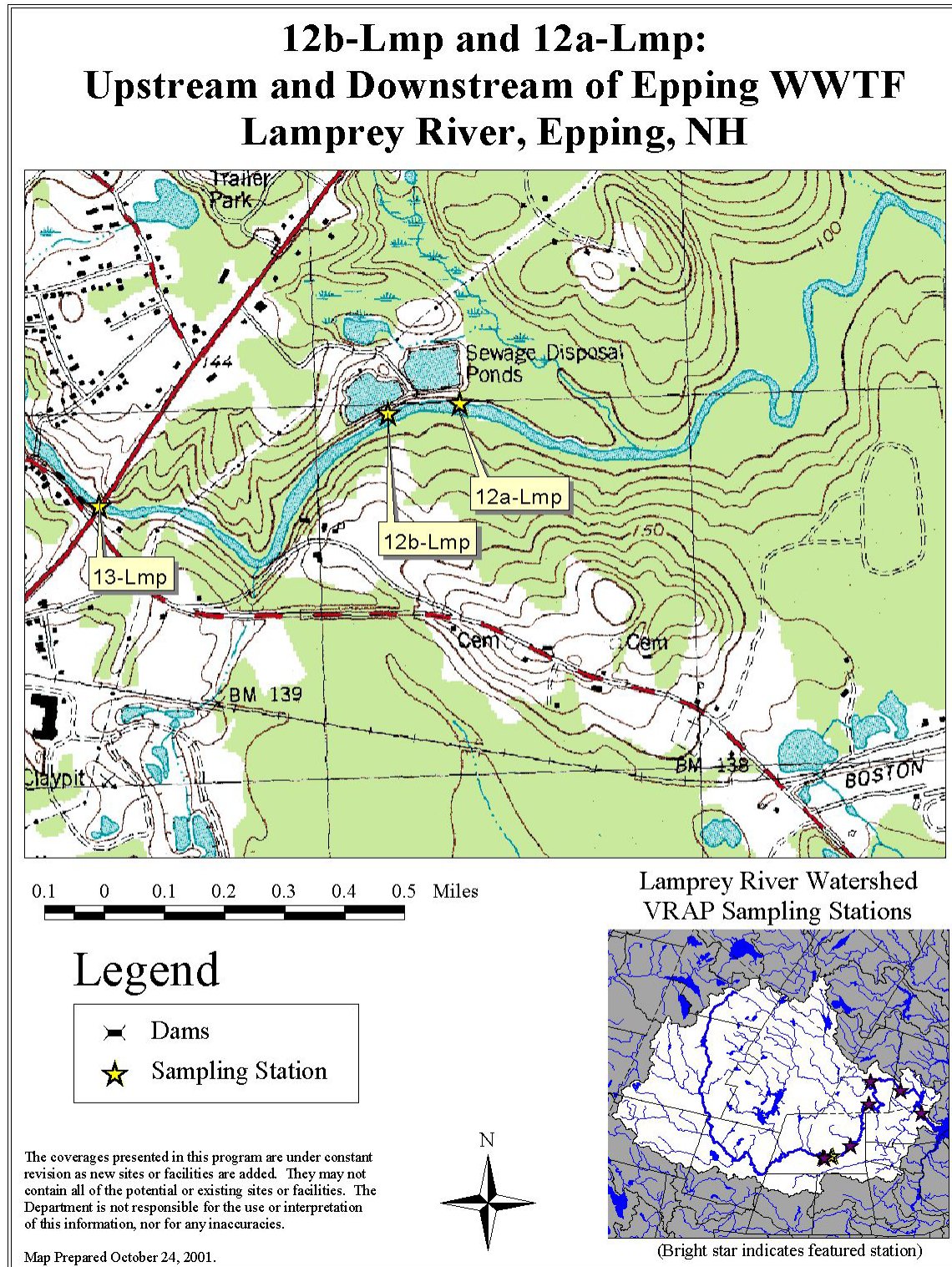
- *Dissolved Oxygen:* Keeping a record of DO will help to determine natural fluctuations and provide early detection of changes in the river. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

Volunteers are encouraged to conduct future sampling efforts in the early morning (5:00-8:00 a.m.) to obtain the lowest, or worst-case, DO concentration readings. Sampling within the early morning hours will help alert volunteers and DES to concentrations below the standard.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Sampling Program.

- *pH:* Volunteers can help determine if this location in the river meets the pH standard by providing DES with additional water quality data and information about the influences affecting water quality at this station. This process will not be completed in the short term, because of the variability of water quality and the amount of research required. Volunteers should plan to follow one of the three phases previously described each year, until a determination can be made in cooperation with DES.

3.3. 12b-Lmp: Upstream of Epping WWTF, Epping, NH



3.3.1. Results and Discussion

Seven measurements for dissolved oxygen, pH, turbidity, and conductivity, were made in the field using handheld meters. All measurements and samples met the QA/QC requirements, and all data indicate that the Lamprey River at 12b-Lmp in the year 2000 meets Class B Water Quality Standards for the parameters evaluated (see Table 3).

Table 3. Monitoring Summary: 12b-Lmp. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standard
DO (mg/L)	7	7	0	7.25 - 9.7	>5
DO (% sat.)	7	7	0	81.3 - 86.6	>75
pH (Std. Units)	7	7	0	6.51 - 7.46	6.5-8.0
Turbidity (NTUs)	7	7	0	0.9 - 7.9	<10 NTU above background
Conductivity (μmho/cm)	7	7	0	108.7 - 176.3	NA

3.3.1.1. Dissolved Oxygen

Figure 4 shows the DO concentration and water temperature during 2000. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % sat. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Therefore, additional DO saturation data collected at this location are needed.

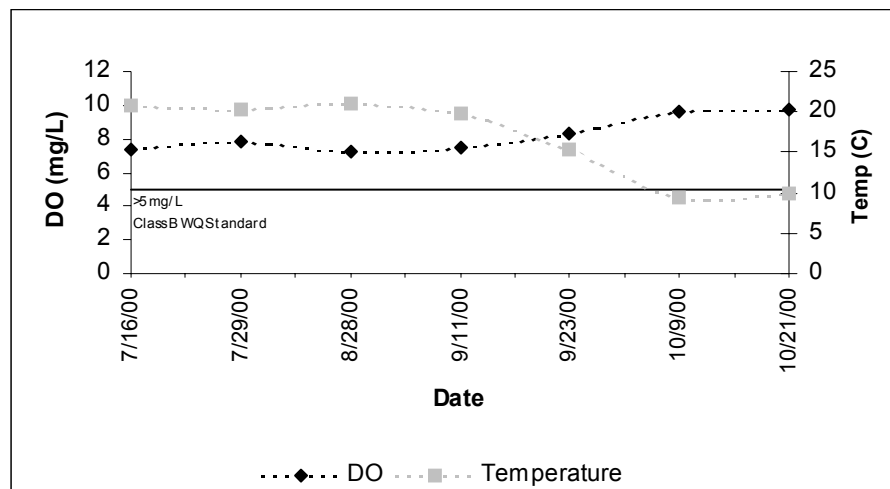


Figure 4. Dissolved Oxygen (DO) Concentration vs. Temperature. Lamprey River at 12b-Lmp, Upstream of Epping WWTF, Epping, NH. VRAP, Year 2000.

3.3.2. Recommendations

- *Baseline Monitoring:* Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all weather conditions. VRAP volunteers are making an increasing amount of water quality data available, in some locations for the very first time. The sampling that has taken place has helped create the recommendations in this report, and VRAP monitoring augments the data collection and river management efforts of DES as well as local decision makers. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations.

Special attention should be paid to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with the water quality data. Without a record of weather conditions, it is difficult to speculate on the cause of water quality conditions.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

Volunteers are encouraged to conduct future sampling efforts in the early morning (5:00-8:00 a.m.), when DO levels are typically lowest. Results obtained during the afternoon hours may not reveal incidences of oxygen depletion in the river, although this information will contribute to the documentation of daily and seasonal water quality variability. Samples within the early morning hours will help determine the lowest concentrations of oxygen in the river, and help alert volunteers and DES to concentrations below the standard.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

3.4. 12a-Lmp: Downstream of Epping WWTF, Epping, NH

See map in Section 3.3 for station location.

3.4.1. Results and Discussion

Nine measurements for dissolved oxygen, turbidity, and conductivity, were made, while seven were made for pH in the field using handheld meters. All measurements and samples met the QA/QC requirements, and all data indicate that the Exeter River at 12-Ext in the year 2000 meets Class B Water Quality Standards for the parameters evaluated (see Table 4).

Table 4. Monitoring Summary: 12a-Lmp. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standard
DO (mg/L)	7	7	0	7.09 - 9.8	>5
DO (% sat.)	7	7	0	81.2 - 86.9	>75
pH (Std. Units)	7	7	1	6.29 - 7.32	6.5-8.0
Turbidity (NTUs)	7	7	0	0.85 - 17	<10 NTU above background
Conductivity (µmho/cm)	7	7	0	135.1 - 635	NA
<i>E. coli</i> (CTS/100mL)	5	5	0	30 - 290	<406

3.4.1.1. Dissolved Oxygen

Dissolved oxygen concentrations remained above the minimum instantaneous requirement of 5 mg/L (see Figure 5). However, the sampling was conducted after the ideal period for catching worst case DO conditions (6:00-8:00 a.m.).

The Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day.

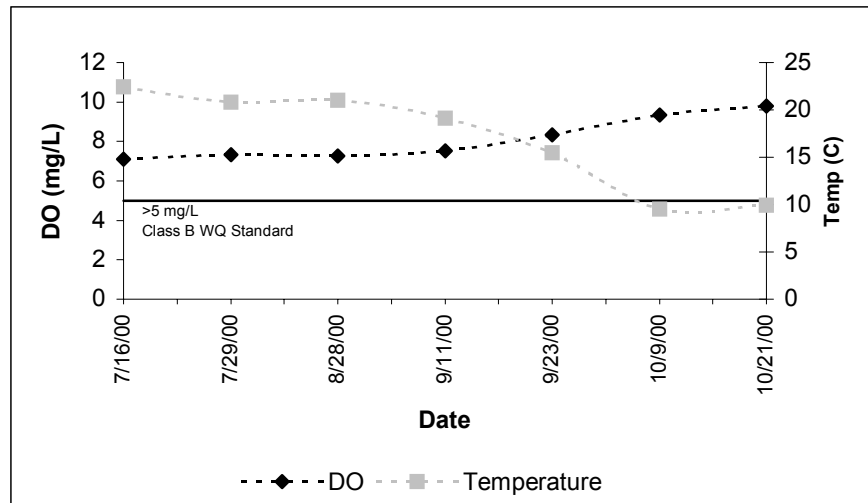


Figure 5. Dissolved Oxygen (DO) Concentration vs. Temperature. Lamprey River at 12a-Lmp, Downstream of Epping WWTF, Epping, NH. VRAP, Year 2000.

3.4.1.2. pH

The pH measurement below the state standard occurred on September 11, 2000.

Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands, then the low pH measurements are not considered a violation of water quality standards. Additional information about factors influencing pH levels at this site is needed. Weather analysis would also be useful for determining if pH at this site may be a problem, as other sites along the Lamprey River also show pH measurements below the standard on this date.

3.4.1.3. *E. coli*

Bacteria counts at 12a-Lmp were within standards throughout the summer of 2000 (Figure 6). However, bacteria counts over a period of sixty days showed results below the standard range. Analysis of weather effects on these results was not conducted due to a lack of information about weather conditions.

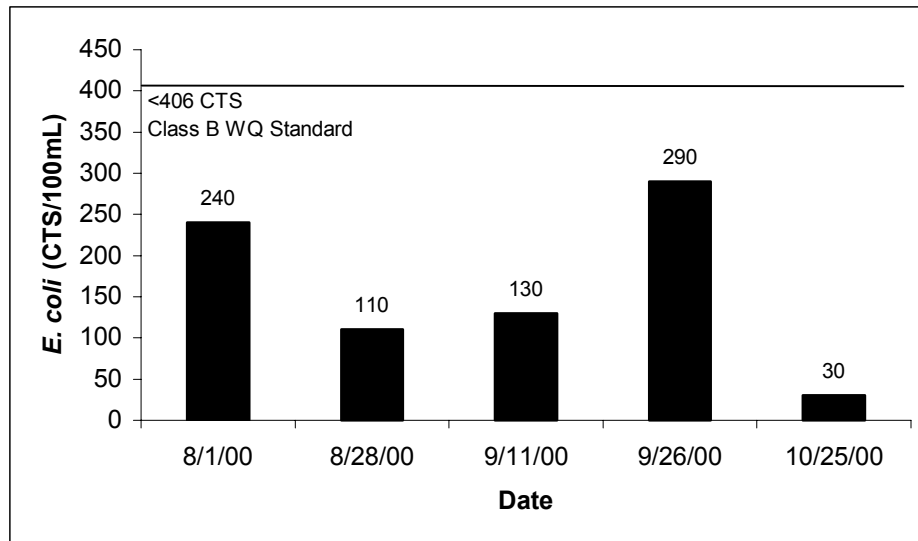


Figure 6. *E. coli* Bacteria Counts. Lamprey River at 12a-Lmp, Downstream of Epping WWTF, Epping, NH. VRAP, Year 2000.

3.4.2. Recommendations

- Baseline Monitoring:** Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all weather conditions. VRAP volunteers are making an increasing amount of water quality data available, in some locations for the very first time. The sampling that has taken place has helped create the recommendations in this report, and VRAP monitoring augments the data collection and river management efforts of DES as well as local decision makers. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations.

Special attention should be paid to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with the water quality data. Without a record of weather conditions, it is difficult to speculate on the cause of water quality conditions.

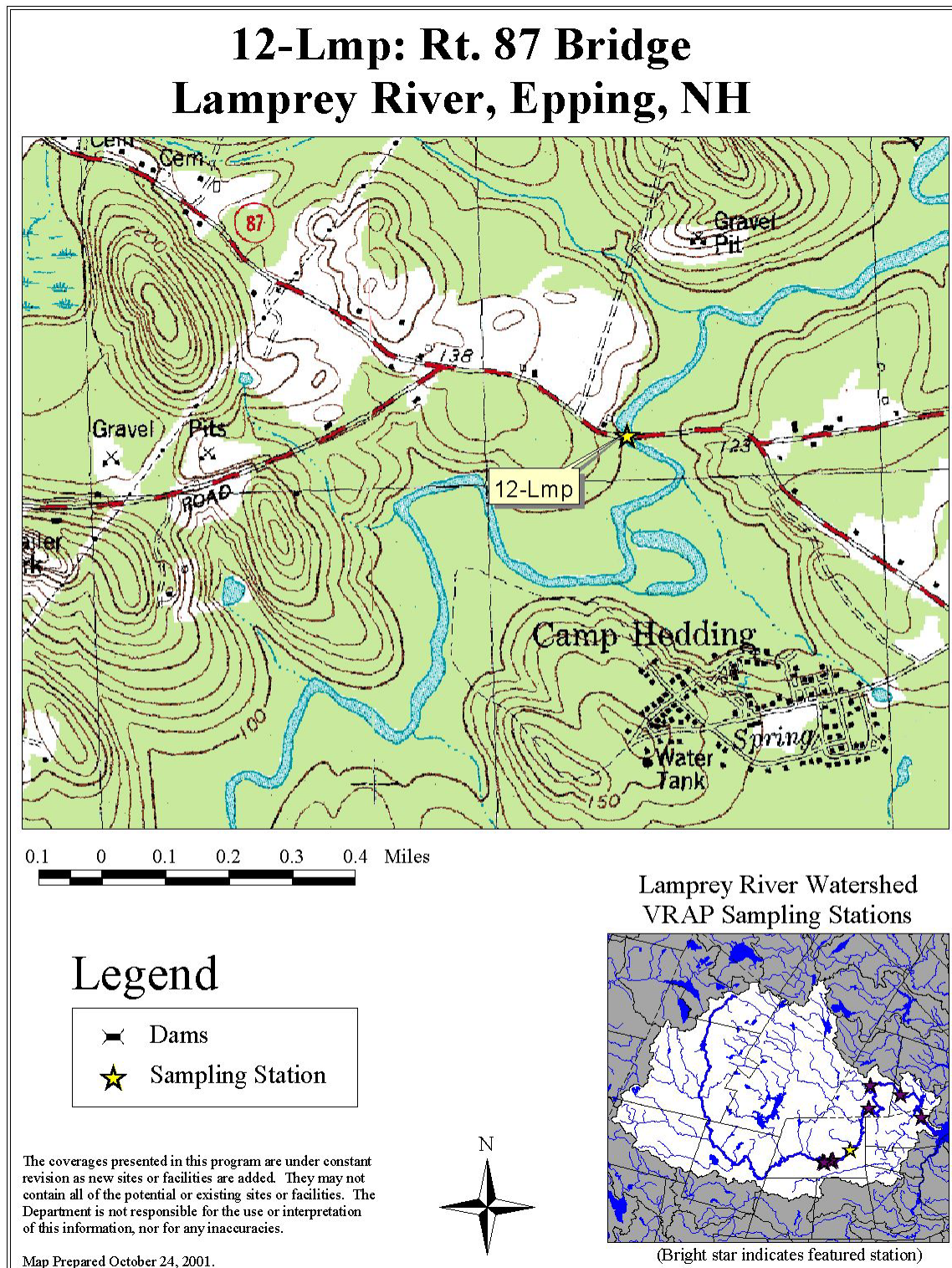
- Dissolved Oxygen:** Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

Volunteers are encouraged to conduct future sampling efforts in the early morning (5:00-8:00 a.m.), when DO levels are typically lowest. Results obtained during the afternoon hours may not reveal incidences of oxygen depletion in the river,

although this information will contribute to the documentation of daily and seasonal water quality variability. Samples within the early morning hours will help determine the lowest concentrations of oxygen in the river, and help alert volunteers and DES to concentrations below the standard.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

3.5. 12-Lmp: Route 87 Bridge, Epping, NH



3.5.1. Results and Discussion

Eight measurements for dissolved oxygen, pH, turbidity, and conductivity were made in the field using handheld meters. Six samples were collected for *E. coli* bacteria. All measurements and samples met the QA/QC requirements, but pH data may indicate that the Lamprey River at 12-Lmp in the year 2000 does not meet Class B Water Quality Standards for the parameters evaluated (see Table 5).

Table 5. Monitoring Summary: 12-Lmp. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards
DO (mg/L)	8	8	0	6.8 - 9.6	>5
DO (% sat.)	8	8	0	75.8 - 85.1	>75
pH (Std. Units)	8	8	1	6.38 - 7.11	6.5-8.0
Turbidity (NTUs)	8	8	0	1 - 4.9	<10 NTU above background
Conductivity (μmho/cm)	8	8	0	128.4 - 231.8	NA
<i>E. coli</i> (CTS/100mL)	6	6	0	10 - 330	<406

3.5.1.1. Dissolved Oxygen

Figure 7 shows the DO concentrations during summer 2000. Dissolved oxygen in the river at 12-Lmp was always above the minimum required concentration of 5 mg/L (see Figure 5). The Class B New Hampshire surface water quality standard for DO is a minimum concentration of 5.0 mg/L **and** minimum saturation of 75%. In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. An accurate determination of whether the DO standard is met for % saturation can only be done using multiple measurements of saturation collected during any single day. Additional sampling is necessary at this location.

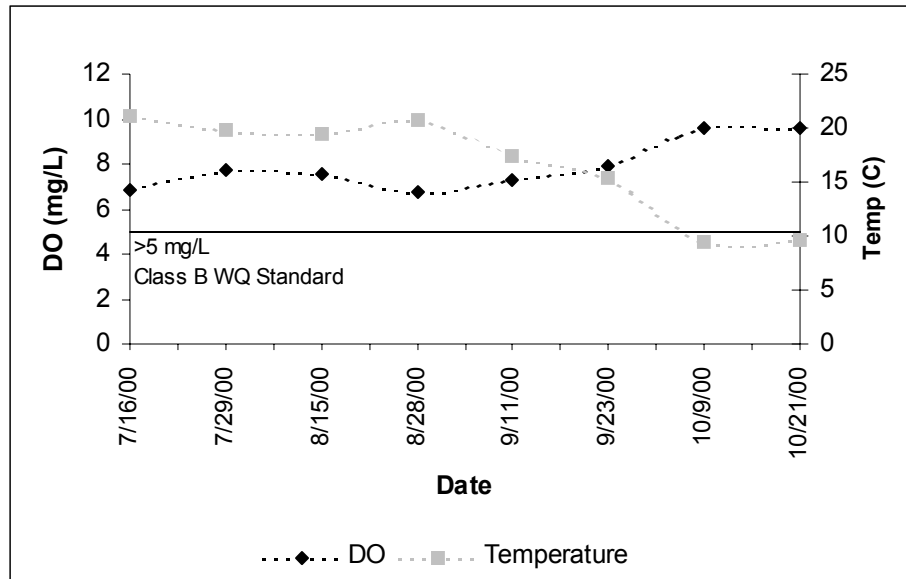


Figure 7. Dissolved Oxygen (DO) Concentration vs. Temperature. Lamprey River at 12-Lmp, Route 87 Bridge, Epping, NH. VRAP, Year 2000.

3.5.1.2. pH

The pH measurement below the state standard occurred on September 11, 2000. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands, then the low pH measurements are not considered a violation of water quality standards. Additional information about factors influencing pH levels at this site is needed. Weather analysis would also be useful for determining if pH at this site may be a problem, as other sites along the Lamprey River also show pH measurements below the standard on this date.

3.5.1.3. *E. coli*

E. coli bacteria levels were within the state standard throughout the summer of 2000 (Figure 8). Additional information about weather conditions and site location will help to analyze the rise in bacteria counts.

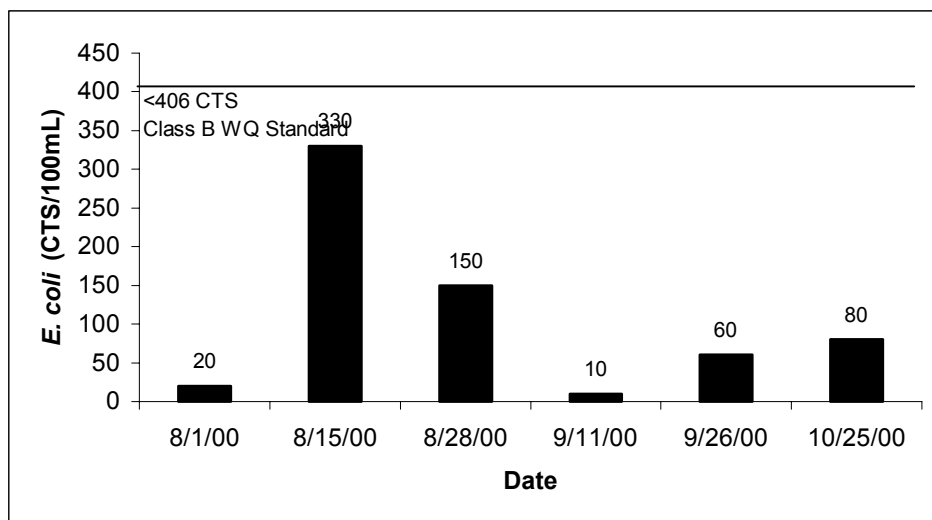


Figure 8. *E. coli* Bacteria Counts. Lamprey River at 12-Lmp, Route 87 Bridge, Epping, NH. VRAP, Year 2000.

3.5.2. Recommendations

- Baseline Monitoring:** VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report. Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all weather conditions, and to ensure that this area of the river remains within standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES, as well as local decision makers.

Special attention should be paid to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with the water quality data. Without a record of weather conditions, it is extremely difficult to speculate on the cause of water quality conditions.

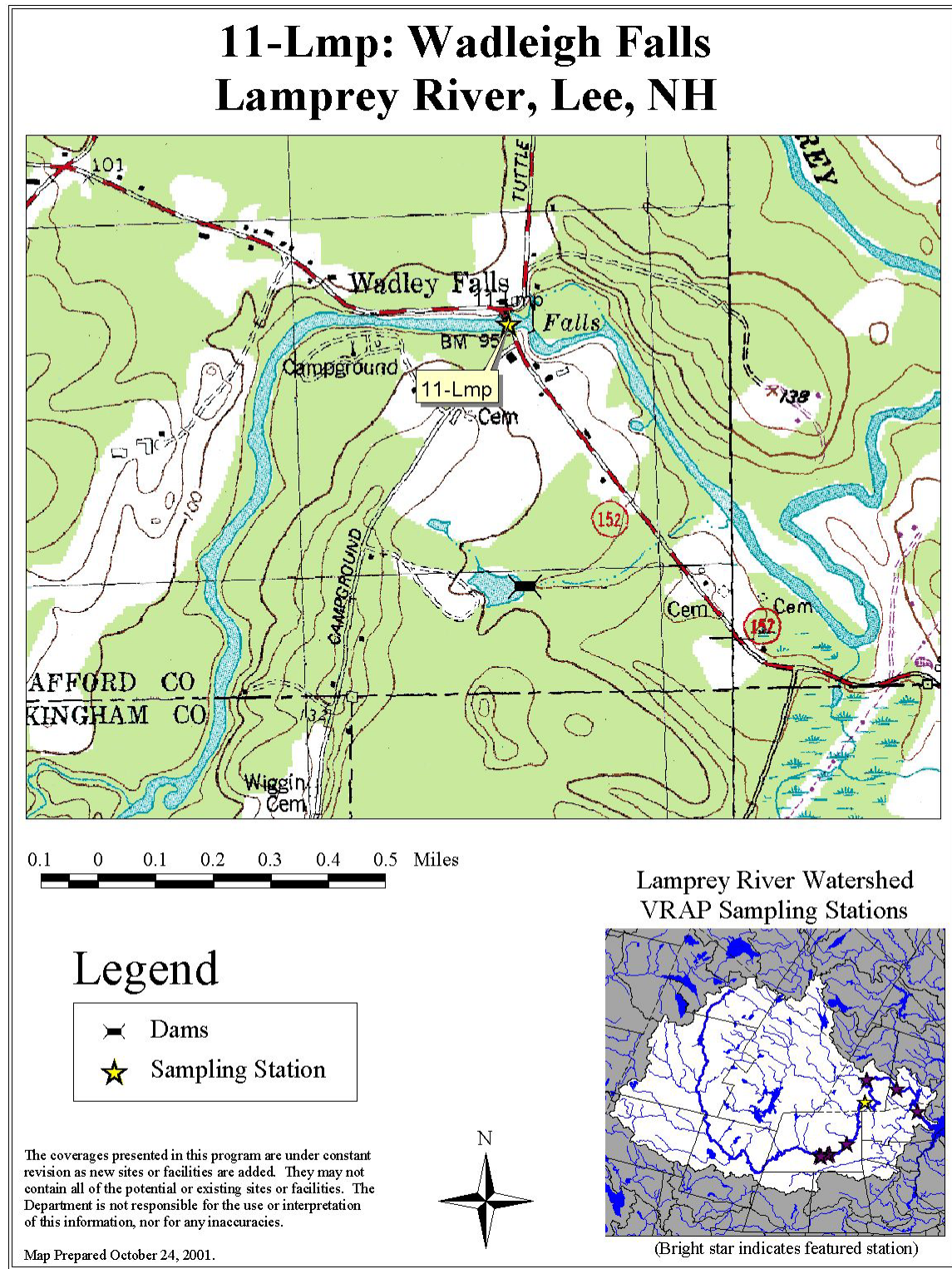
- Dissolved Oxygen:** Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

Volunteers are encouraged to measure the percent saturation during the early morning hours (6:00-8:00 a.m.) and the mid-late afternoon hours (3:00-5:00 p.m.) to begin investigation into DO saturation in the river. Early morning samples usually represent the lowest DO concentrations, while mid-late afternoon samples represent the highest DO concentrations in the river. These data points will provide volunteers and DES with worst and best-case scenarios of DO saturation at this location.

- *pH*: See recommendations for 13'-Lmp in Section 3.1.2.

3.6. 11-Lmp: Wadley Falls, Lee, NH



3.6.1. Results and Discussion

Six samples were collected for *E. coli* bacteria, all of which met the QA/QC requirements (Table 6). Results indicate that the Lamprey River at 11-Lmp in the year 2000 meets Class B Water Quality Standards for *E. coli*.

Table 6. Monitoring Summary: 11-Lmp. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standard
<i>E. coli</i> CTS/100mL	6	6	0	20 - 340	<406

3.6.1.1. *E. coli*

E. coli bacteria levels were within the state standard throughout the summer of 2000 (Figure 9). Additional information about weather conditions and site location will help to analyze the rise in bacteria counts.

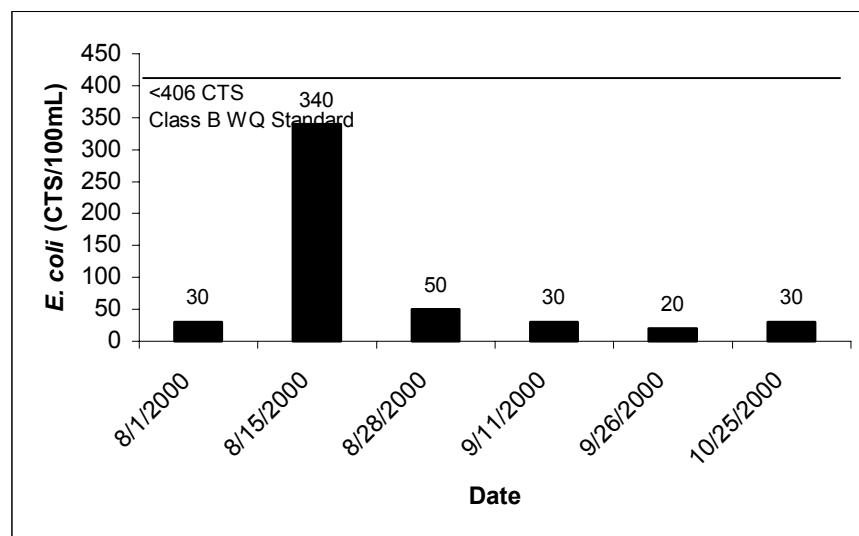


Figure 9. *E. coli* Bacteria Counts. Lamprey River at 11-Lmp, Wadley Falls, Lee, NH. VRAP, Year 2000.

3.6.2. Recommendations

- **Baseline Monitoring:** VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report. Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality

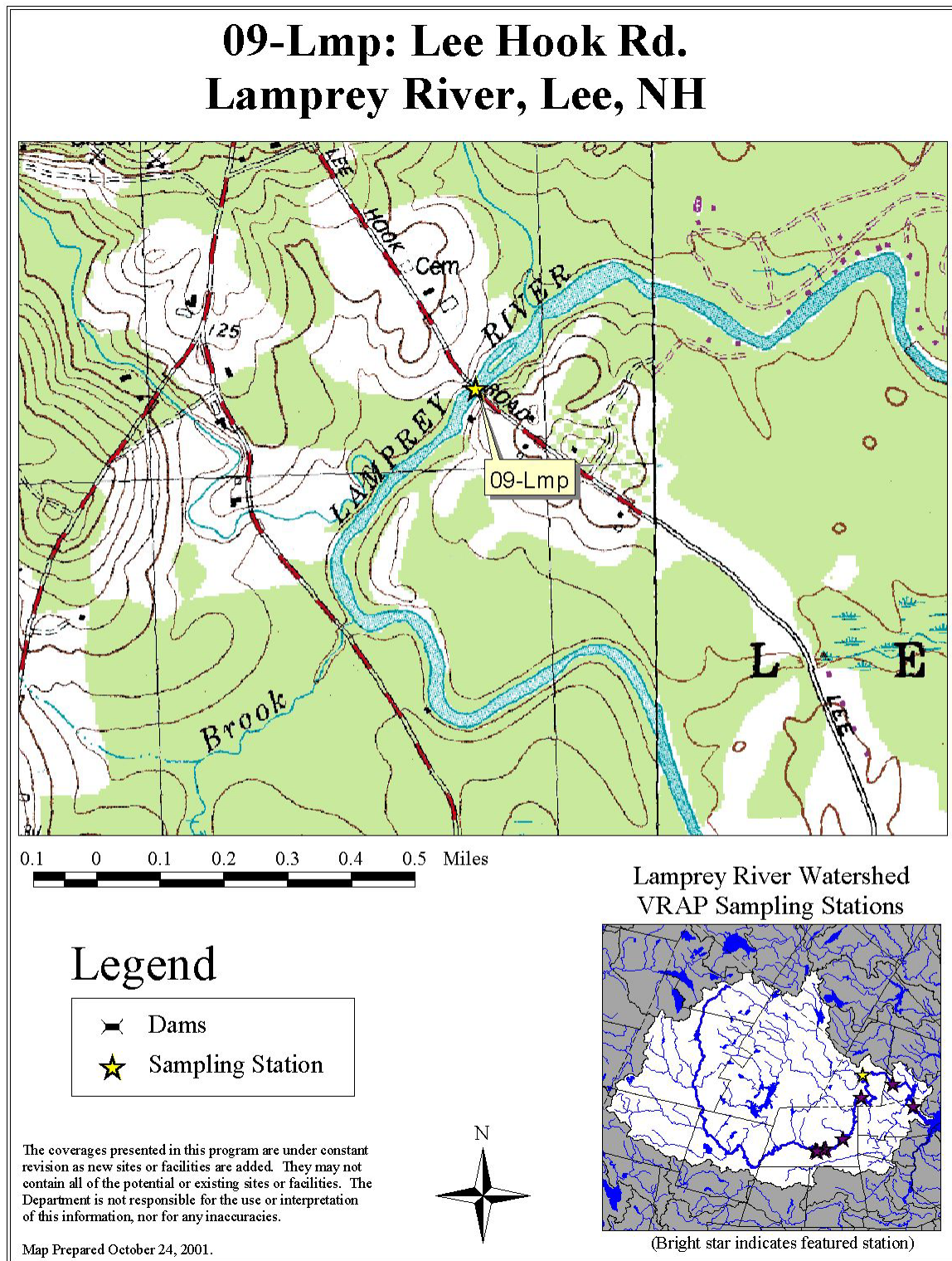
during all weather conditions, and to ensure that this area of the river remains within standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES, as well as local decision makers.

Special attention should be paid to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with the water quality data. Without a record of weather conditions, it is extremely difficult to speculate on the cause of water quality conditions.

- *E. coli*: Continued bacteria sampling at this location is encouraged. Special attention should be paid to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with the water quality data. Without a record of weather conditions, it is difficult to speculate on the cause of water quality conditions.

If possible, at least three samples during a sixty-day period should be collected. Although any single sample containing more than 406 CTS/100mL is considered an exceedance of water quality standards, a geometric mean (a type of average) of three or more samples, as written in the surface water quality standards, is more descriptive of overall river conditions, and helps to confirm persistence of potential bacteria contamination.

3.7. 09-Lmp: Lee Hook Rd, Lee, NH



3.7.1. Results and Discussion

Seven measurements for dissolved oxygen, pH, turbidity, and conductivity were made in the field using handheld meters, all of which met the QA/QC requirements. The data indicate that the Lamprey River at 09-Lmp in the year 2000 meets Class B Water Quality Standards for the parameters evaluated (see Table 7).

Table 7. Monitoring Summary: 09-Lmp. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standard
DO (mg/L)	7	7	0	7.35 - 9.64	>5
DO (% sat.)	7	7	0	82.1 - 87.8	>75
pH (Std. Units)	7	7	0	6.56 - 7.11	6.5-8.0
Turbidity (NTUs)	7	7	0	1.5 - 4.3	<10 NTU above background
Conductivity (µmho/cm)	7	7	0	52.2 - 163.6	NA

3.7.1.1. Dissolved Oxygen

Dissolved oxygen concentrations remained above the minimum instantaneous requirement of 5 mg/L throughout the summer (Figure 10). The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Although volunteer results revealed adequate DO concentration and saturation, additional sampling for saturation is required at this station.

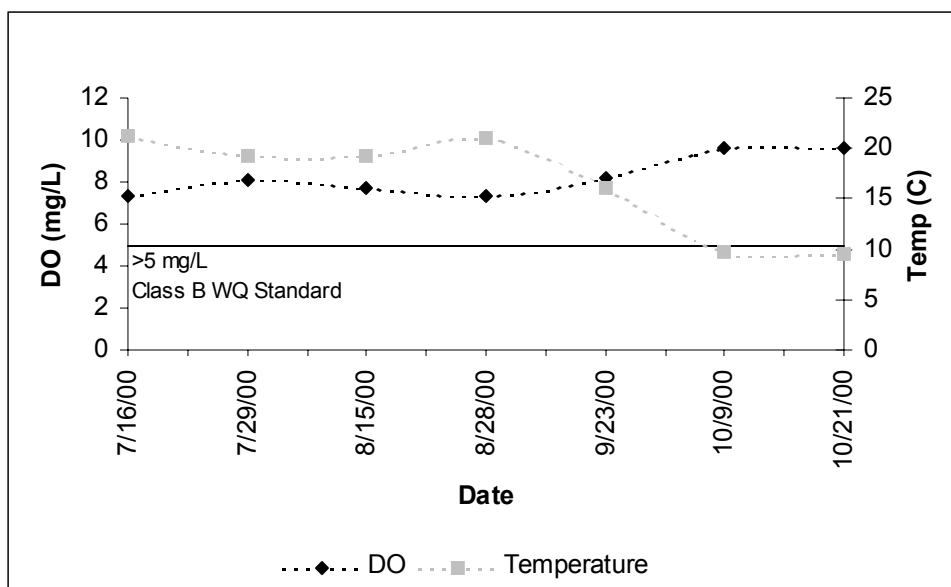


Figure 10. Dissolved Oxygen (DO) Concentration vs. Temperature. Lamprey River at 09-Lmp, Lee Hook Rd, Lee, NH. VRAP, Year 2000.

3.7.2. Recommendations

- Baseline Monitoring:** VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report. Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all weather conditions, and to ensure that this area of the river remains within standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES, as well as local decision makers.

Special attention should be paid to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with the water quality data. Without a record of weather conditions, it is extremely difficult to speculate on the cause of water quality conditions.

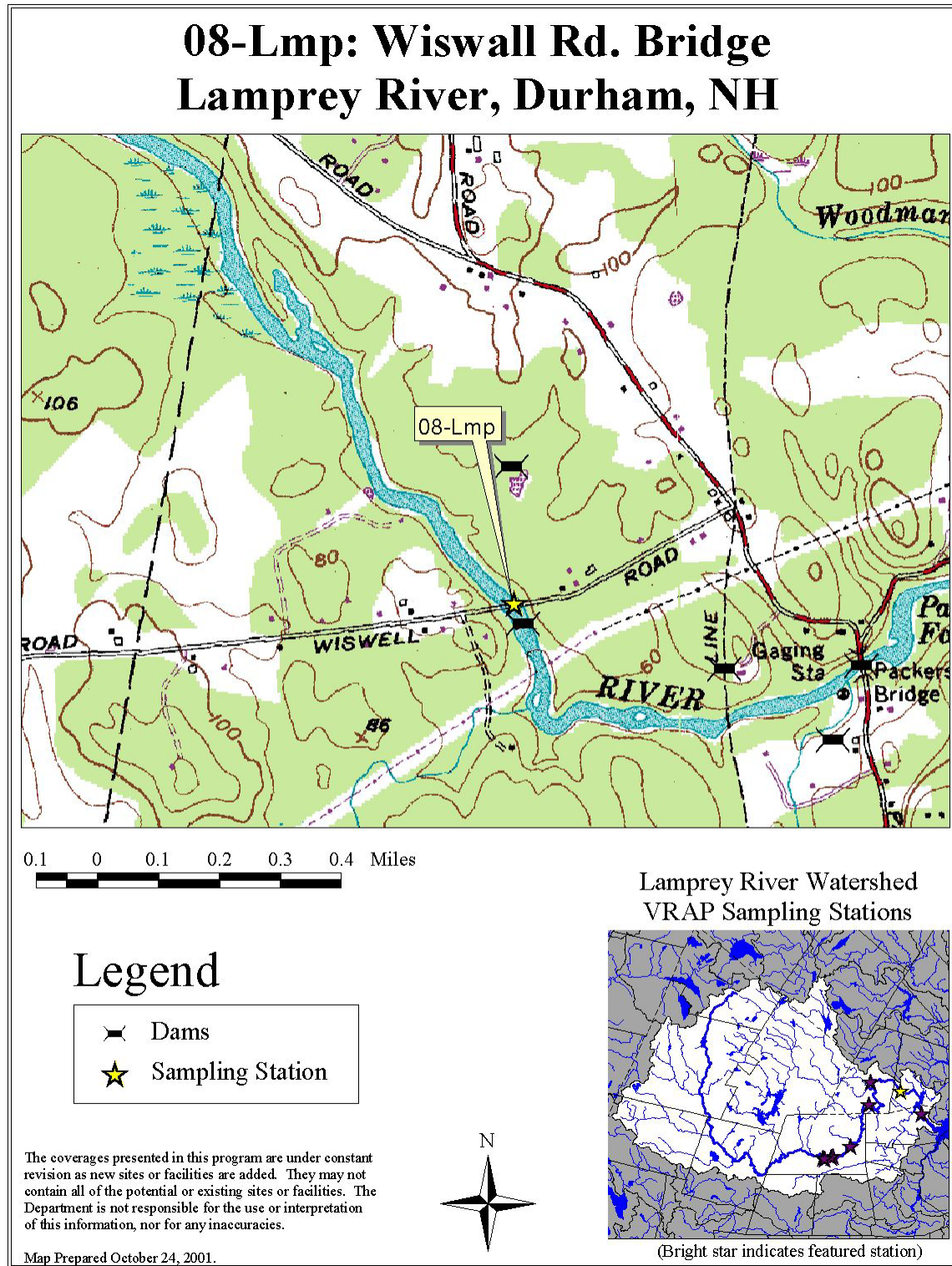
- Dissolved Oxygen:** Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum

instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

Volunteers are encouraged to measure the percent saturation during the early morning hours (6:00-8:00 a.m.) and the mid-late afternoon hours (3:00-5:00 p.m.) to begin investigation into DO saturation in the river. Early morning samples usually represent the lowest DO concentrations, while mid-late afternoon samples represent the highest DO concentrations in the river. These data points will provide volunteers and DES with worst and best-case scenarios of DO saturation at this location.

3.8. 08-Lmp: Wiswall Road Bridge, Durham, NH



3.8.1. Results and Discussion

Seven measurements for dissolved oxygen, pH, turbidity, and conductivity were made in the field using handheld meters, while six samples were collected for *E. coli* bacteria. All measurements and samples met the QA/QC requirements, but pH data may indicate that the Lamprey River at 12-Lmp in the year 2000 does not meet Class B Water Quality Standards (see Table 8).

Table 8. Monitoring Summary: 08-Lmp. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standards
DO (mg/L)	7	7	0	7.43 - 9.71	>5
DO (% sat.)	7	7	0	81.5 - 92.9	>75
pH (Std. Units)	7	7	2	6.3 - 7.35	6.5-8.0
Turbidity (NTUs)	7	7	0	1.3 - 2.3	<10 NTU above background
Conductivity (µmho/cm)	7	7	0	105.1 - 180.2	NA
<i>E. coli</i> (CTS/100mL)	6	6	0	<10 - 240	<406

3.8.1.1. Dissolved Oxygen

Dissolved oxygen concentrations remained above the minimum instantaneous requirement of 5 mg/L (Figure 11). The saturation of dissolved oxygen at this site appears to be meeting the water quality standards. The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Although volunteer results revealed adequate DO concentration and saturation, additional sampling for saturation is required at this station.

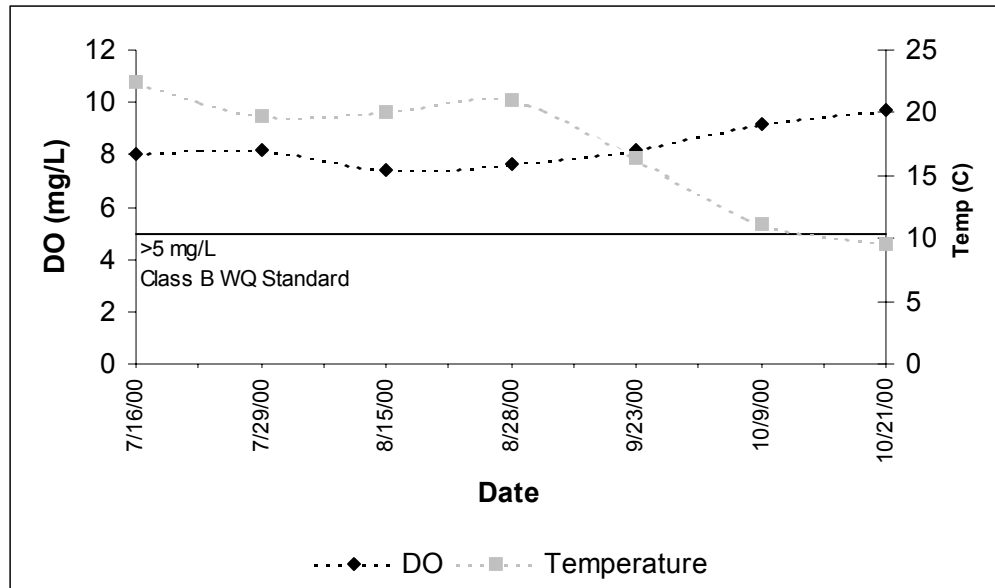


Figure 11. Dissolved Oxygen (DO) Concentration vs. Temperature. Lamprey River at 08-Lmp, Wiswall Road Bridge, Durham, NH. VRAP, Year 2000.

3.8.1.2. pH

The pH at this location was measured below the state standard range on July 29 and October 21, 2000. Low pH was recorded twice, near the end of the summer of 1999. This may indicate that these levels are natural. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands, then the low pH measurements are not considered a violation of water quality standards. Additional information about factors influencing pH levels at this site is needed. Weather analysis would also be useful for determining if pH at this site may be a problem.

3.8.1.3. *E. coli*

E. coli bacteria levels were within the state standard throughout the summer of 2000 (Figure 12). Additional information about weather conditions and site location will help to analyze the rise in bacteria counts like the one seen throughout the Lamprey sites on August 15, 2000.

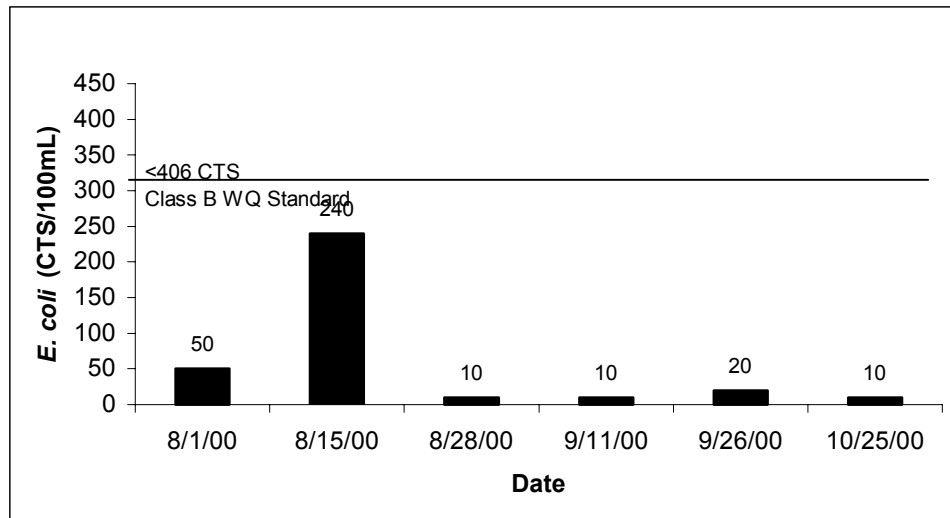


Figure 12. *E. coli* Bacteria Counts. Lamprey River at 08-Lmp, Wiswall Road Bridge, Durham, NH. VRAP, Year 2000.

3.8.2. Recommendations

- Baseline Monitoring:** VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report. Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all weather conditions, and to ensure that this area of the river remains within standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES, as well as local decision makers.

Special attention should be paid to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that weather conditions are provided to VRAP along with the water quality data. Without a record of weather conditions, it is extremely difficult to speculate on the cause of water quality conditions.

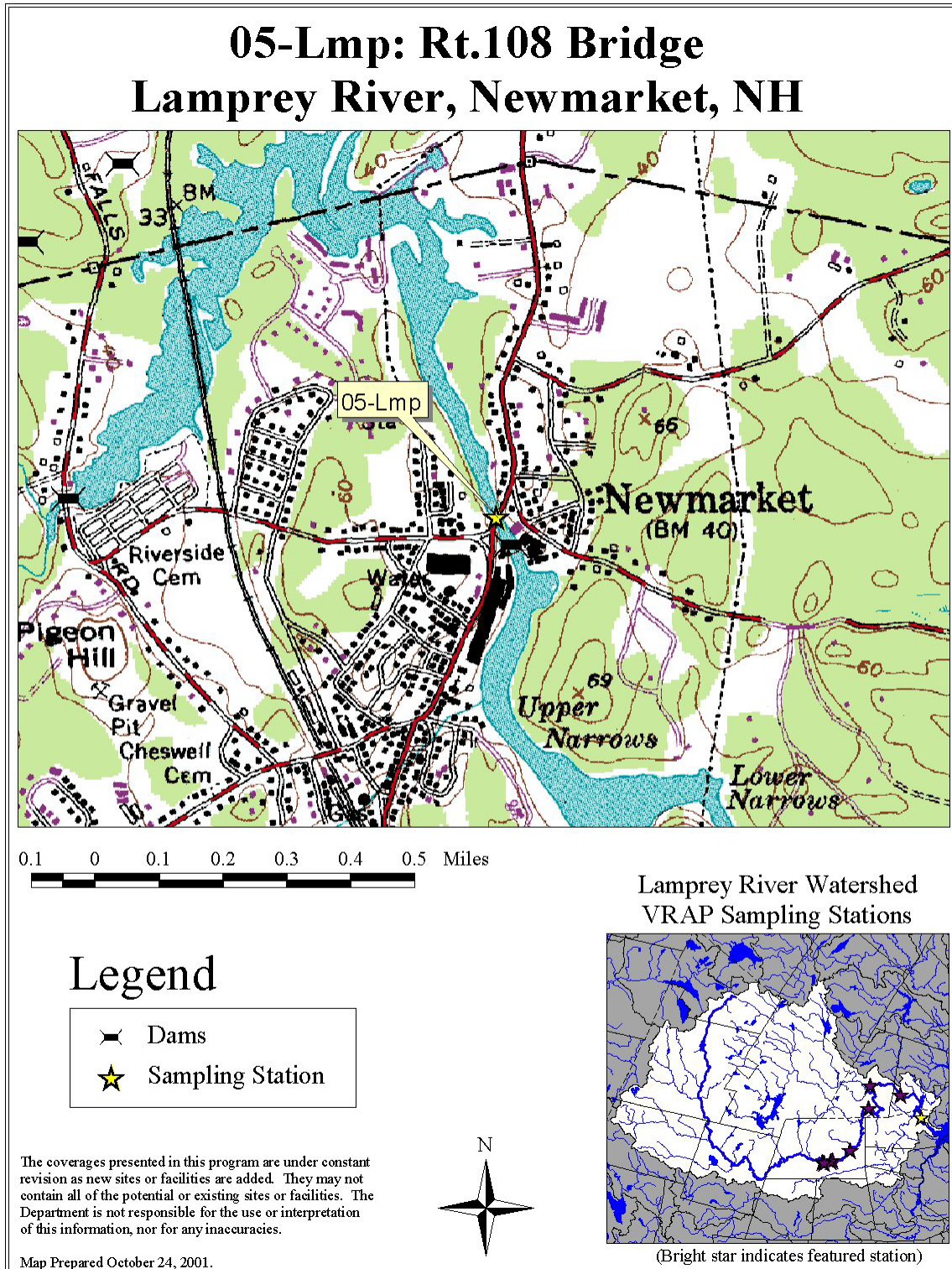
- Dissolved Oxygen:** Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

Volunteers are encouraged to measure the percent saturation during the early morning hours (6:00-8:00 a.m.) and the mid-late afternoon hours (3:00-5:00 p.m.) to begin investigation into DO saturation in the river. Early morning samples usually represent the lowest DO concentrations, while mid-late afternoon samples represent the highest DO concentrations in the river. These data points will provide volunteers and DES with worst and best-case scenarios of DO saturation at this location.

- *pH*: See recommendations for 13'-Lmp in Section 3.1.2.

3.9. 05-Lmp: Rte 108 Bridge, Newmarket, NH



3.9.1. Results and Discussion

Six measurements for dissolved oxygen, pH, turbidity, and conductivity were made in the field using handheld meters. All measurements met the QA/QC requirements, but pH and dissolved data may indicate that the Lamprey River at 12-Lmp in the year 2000 does not meet Class B Water Quality Standards (see Table 9).

Table 9. Monitoring Summary: 05-Lmp. VRAP, Year 2000.

Parameter	Samples Collected	Samples Meeting QA/QC Requirements	Acceptable Samples Not Meeting State Criteria	Data Range	Standard
DO (mg/L)	6	6	0	6.36 - 8.12	>5
DO (% sat.)	6	6	1	72.4 - 94.2	>75
pH (Std. Units)	6	6	1	5.83 - 7.23	6.5-8.0
Turbidity (NTUs)	6	6	0	1.3 - 2.4	<10 NTU above background
Conductivity (µmho/cm)	6	6	0	144.9 - 173.8	NA

3.9.1.1. Dissolved Oxygen

Dissolved oxygen concentrations remained above the minimum instantaneous requirement of 5 mg/L throughout the summer, however there was one instance of DO saturation below the state criteria (See Figure 13). The Class B New Hampshire surface water quality standards for DO include a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 % of saturation (% sat.). In other words, there are criteria for both concentration and saturation that must be met before the river can be considered as meeting DO standards. Although volunteer results revealed adequate DO concentration and saturation, additional sampling for saturation is required at this station.

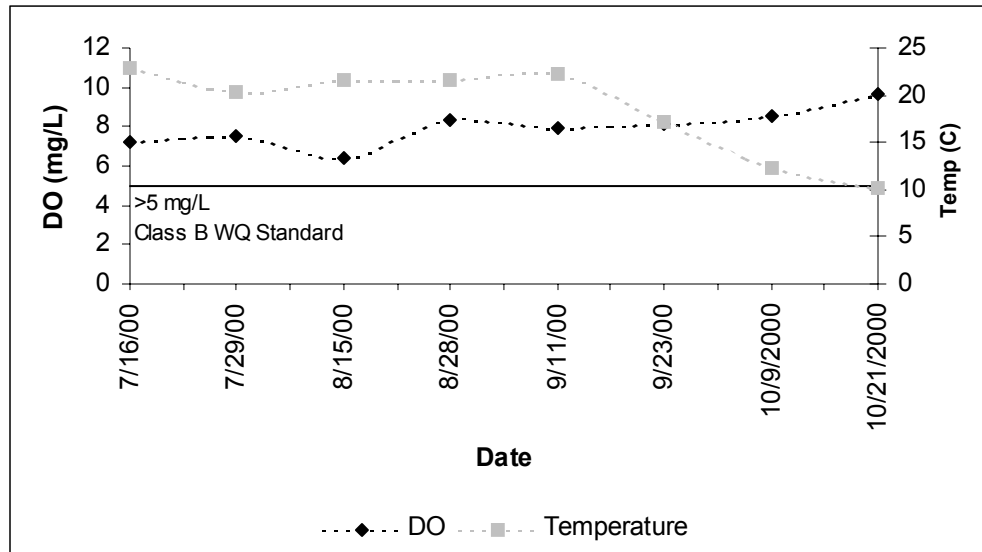


Figure 13. Dissolved Oxygen (DO) Concentration vs. Temperature. Lamprey River at 05-Lmp, Rte 108 Bridge, Newmarket, NH. VRAP, Year 2000.

3.9.1.2. pH

The pH at this location was measured below the state standard range on October 21, 2000. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands, then the low pH measurements are not considered a violation of water quality standards. Additional information about factors influencing pH levels at this site is needed. Weather analysis would also be useful for determining if pH at this site may be a problem.

3.9.2. Recommendations

- Baseline Monitoring:** VRAP volunteers are making water quality data available across the State of New Hampshire, in some locations for the very first time. Prior to volunteer monitoring efforts, very little information about the river in this location was available. The volunteer sampling that has taken place has helped create the recommendations in this report. Volunteers are encouraged to continue baseline monitoring activities at this location to establish a record of water quality during all weather conditions, and to ensure that this area of the river remains within standards. The more information in the baseline data set, the more will be known about the river's water quality dynamics, or variations. Volunteer monitoring augments the data collection and river management efforts of DES, as well as local decision makers.

Special attention should be paid to weather conditions previous to and during the time of sampling. For data interpretation purposes, it is extremely important that

weather conditions are provided to VRAP along with the water quality data. Without a record of weather conditions, it is extremely difficult to speculate on the cause of water quality conditions.

- *Dissolved Oxygen:* Keeping a record of DO will help to document variations in the river, and provide early detection of changes in the river. Prior to volunteer monitoring efforts, little information about the river at this location was available. It is important to note that good DO levels at this location help to maintain DO levels downstream. Although the river appears to be meeting the minimum instantaneous DO concentration (5 mg/L) at this location, baseline monitoring should continue with special attention to the time of sampling.

To determine if oxygen saturation in the river at this location falls below water quality standards, monitoring data must represent worst and best-case scenarios of DO saturation. Volunteers working with DES can provide the watershed community with the necessary morning **and** afternoon data points. Arrangements for sampling oxygen saturation in the river more than once per day can be made through VRAP and the Ambient River Monitoring Program.

Volunteers are encouraged to measure the percent saturation during the early morning hours (6:00-8:00 a.m.) and the mid-late afternoon hours (3:00-5:00 p.m.) to begin investigation into DO saturation in the river. Early morning samples usually represent the lowest DO concentrations, while mid-late afternoon samples represent the highest DO concentrations in the river. These data points will provide volunteers and DES with worst and best-case scenarios of DO saturation at this location.

- *pH:* See recommendations for 13'-Lmp in Section 3.1.2.

Appendix A:
List of Stations

Appendix B:
Raw Data Tables

Appendix C:

Parameters and Surface Water Quality Standards

Appendix D:
River Graphs

Appendix E:

Field Sampling Protocols

Appendix F:
List of Volunteers